

RELEASES OF *DINORHYNCHUS DYBOWSKYI* IN U.S.A. (HETEROPTERA: PENTATOMIDAE) AND APPARENT FAILURE TO ESTABLISH¹

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ABSTRACT: During the period of 1979-1981, nymphs of *Dinorhynchus dybowskyi* were released at 4 sites in three states. At Wethersfield, CT, one egg mass (containing 48 eggs) was found indicating successful reproduction had occurred in at least one pair of released individuals. Those eggs successfully overwintered but only 15% hatched due to high mortality, including 21% parasitism by *Anastatus japonicus* (= *disparis*). Field surveys in 1982, 1983 and 1995 at former release sites all failed to reveal any evidence of *D. dybowskyi* establishment.

Dinorhynchus dybowskyi Jakovlev (Heteroptera: Pentatomidae: Asopinae) is an arboreal predator of lepidopteran and coleopteran larvae in eastern Asia. Biological details were previously published (Schaefer *et al.* 1979), in anticipation of *D. dybowskyi* being released in the U.S. as a potential natural enemy of the gypsy moth, *Lymantria dispar* (L.) (Lepidoptera: Lymantridae). Culminating efforts to introduce *D. dybowskyi* as a beneficial predator of larvae, pupae, and adults of the gypsy moth, I report herein on the releases made and the eventual outcome — the apparent failure of *D. dybowskyi* to establish.

METHODS

All rearing methods employed have appeared previously (Schaefer *et al.* 1979), except egg masses collected in Japan that were held in outdoor screen cages until early spring and subsequently sent under permit to the Beneficial Insects Introduction Research quarantine facility at Newark, Delaware. There, eggs were held in periodically moistened petri dishes with screen vents in the lids. Upon hatching, nymphs were provided only with distilled water in cotton wicks. After first molt, nymphs were provided *ad libitum* with early instar gypsy moth larvae. When the majority of nymphs were in the 2nd and 3rd stadia, they were prepared for release.

Releases: At the time of field release, the standard paper shipping containers were opened and active *D. dybowskyi* nymphs were allowed to crawl from the container onto the bark of oaks (*Quercus* spp.) or other trees known to be infested with gypsy moth. To distribute nymphs over a wider area, only 12 - 14 nymphs were placed on each mature tree, but selected trees were generally those with contiguous crowns to provide easy access to nearby trees should food become scarce.

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Recovery Attempts: At each release site, during fall after leaves had fallen, at least one egg mass search was made. Searches consisted of carefully looking for the double rows of vertical eggs characteristic of *D. dybowskyi* (see Schaefer *et al.* 1979, Fig. 1). Tree boles (especially on smooth barked trees) were searched for eggs, as suggested by previous experience and observations made in northern Japan.

Final Survey: In the early spring of 1995, a final follow-up survey was made at each of the 1981-82 release sites to determine if any evidence existed that *D. dybowskyi* had survived and established. Because egg masses adhere to tree boles for years, it was believed these egg mass remains could be found to confirm establishment.

RESULTS

Releases: In spring during the years 1979 - 1981, 1,704 nymphs of *D. dybowskyi* were released at 4 sites in 3 states as indicated (Table 1). These releases constitute the only attempt at establishment of this predator in the U.S. to date.

Recovery Evidence and Egg Survival: During 2 to 15 search hours spent per site in the fall of 1980, only one egg mass was found. On December 27, 1980, at Wethersfield, Conn., one *D. dybowskyi* egg mass containing 48 eggs was found on the trunk of a red maple, (*Acer rubrum* L.) tree (dbh 12.7 cm), located 160 cm above ground on the southeast aspect. At this time, a coarse

Table 1. Intentional releases of *Dinorhynchus dybowskyi* in U.S.A., 1979 - 1981.

Location	Date	No. Nymphs Released
Pennsylvania, Wayne Co., Lake Henry	May 31-June 5, 1979	65
Cumberland Co., Col. Denning St. Park	May 9, 1980 May 23, 1981	566 118
Maryland, Cecil Co., Belvidere	May 5, 1980 May 19-22, 1981	515 92
Connecticut, Hartford Co., Wethersfield	May 15, 1980 May 25, 1981	287 61
Total		1,704

grade hardware cloth guard was placed over the egg mass to provide protection during the remainder of the winter. At this time it was noted that seven of the 48 eggs had been damaged by a mandibulate predator.

The *D. dybowskyi* egg mass remained in position until May 25, 1981, when it was ascertained that some eggs had already hatched. The egg mass was removed on a strip of bark, returned to the laboratory, and held for further nymph emergence. This resulted in the emergence of unusually large specimens of *Anastatus disparis* Ashmead (Hymenoptera: Eupelmidae) (Identified by M. Schauff, USDA, SEL, Beltsville, MD) but *A. japonicus* may now be the correct name^a. These eupelmids emerged from ten eggs, while 17 other eggs were damaged by predators. Fourteen others remained inviable from undetermined causes, and only 7 (15%) *D. dybowskyi* eggs had successfully hatched (based on successful removal of the operculum by hatching nymphs).

Final Survey: During the 1995 final field survey, 4.2, 2.5, and 3.3 hours were spent searching the precise release sites in Pennsylvania, Maryland, and Connecticut respectively. No evidence (old or current egg masses) of the presence of *D. dybowskyi* was found anywhere.

DISCUSSION

Although the possibility remains that establishment has occurred but gone undetected, I regard this unlikely given the apparent suitable conditions under which releases occurred and the collective hours spent in search of eggs. Probably insufficient numbers released at any one site was one cause for failure to establish. Another was certainly the unusual environmental resistance observed based on the predation, parasitism and unknown mortality exhibited in the one egg mass found. The fact that this one egg mass was found in Wethersfield, Connecticut and that some nymphs emerged the following spring, suggests that environmental conditions and habitat were suitable for survival during that season, including winter. Clearly one pair (out of 287 nymphs released at the site that season) survived the season, successfully mated, and the female oviposited (probably during September or October 1980).

Concerning the fate of the entire 48 egg complement, it is evident that severe environmental resistance must be overcome to achieve successful establishment since only 15% of the deposited eggs hatched the following spring. Predation by a mandibulate predator, possibly ants or birds, caused 35% mortality, unknown factors caused 29% mortality, and parasitism caused 21% mortality. It is ironic the gypsy moth egg parasitoid, *A. japonicus*, accepted this novel egg mass as a suitable host.

One of two possible explanations exists: (1) that *A. japonicus* is highly opportunistic since a female readily stung newly encountered exotic eggs, or (2) that a re-establishing of an old host-parasite association occurred since *Anastatus* sp. from gypsy moth was first imported and released from both Japan

and Europe in 1908 (at that time this insect was known as *Anastatus bifasciatus*, see Howard & Fiske 1911). This host-parasitoid relationship may simply be the reestablishing of an old association that has been suppressed since 1910 when *A. japonicus* was first established in Massachusetts. Unfortunately, it is uncertain at what levels *A. japonicus* parasitizes eggs of *D. dybowskyi* in eastern Asia (but see footnote³).

Although the effort to introduce *D. dybowskyi* into the gypsy moth natural enemy complex in North America apparently failed, I believe the potential for beneficial impact on gypsy moth populations is sufficient to warrant further efforts to introduce *D. dybowskyi* into North America.

3 Considerable discussion and uncertainty surrounds the correct use of the specific names, *Anastatus disparis* and *A. japonicus*. The Hymenoptera catalog (Burks 1979) continued to recognize *A. disparis* but several others outside the U.S. accept the name *A. japonicus* (Kalina 1981; Zelinskaya 1981; Hirose *et al.* 1968) and indications are that U.S. chalcidoid specialists are increasingly inclined to accept *A. japonicus* (G. Gordh, pers. comm. dtd 18 XI 1976 and M. Schauff, pers. comm. dtd 9 I 1992). However, definitive supportive biological evidence is still needed since attempted crosses of "*A. japonicus*" from gypsy moth eggs in Japan appeared to remain reproductively isolated from the larger "*A. japonicus*" from *Dinorhynchus dybowskyi* eggs also from Japan (R. Fuester and P. Taylor, USDA, Beneficial Insects Res. Lab., Newark, DE, unpubl. 1980 data). This would continue to suggest that a complex of species may be confused herein, now simply placed under the *A. japonicus* name.

In addition to a known association of *A. japonicus* from *D. dybowskyi* eggs in Japan, a dead specimen of *Telenomus* sp. was removed from these same host eggs in February 1979 (Schaefer, unpubl. record, specimen identified by K. Kamijo, Hokkaido Forest Experiment Station, Bibai, Hokkaido, Japan).

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